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The Feynman checkerboard: discrete quantum mechanics

We study the most elementary model of electron motion introduced by R. Feynman. It is a game, in which a checker moves on a checkerboard by certain simple rules, and we count the turnings. We give a first rigorous proof that the model reproduces the (1+1)-dimensional retarded Dirac propagator in the continuum limit, with an explicit estimate of the convergence rate. This justifies a heuristic derivation by J. Narlikar from 1971. In a sense, this is also a continuum limit of a 1-dimensional Ising model with imaginary edge weights (H. Gersh, 1981), and a new approach to making quantum field theory rigorous and algorithmic. For the model, we also show an exact charge conservation and a coupling to lattice gauge theory, and state visual open problems. This is a joint work with A. Ustinov.